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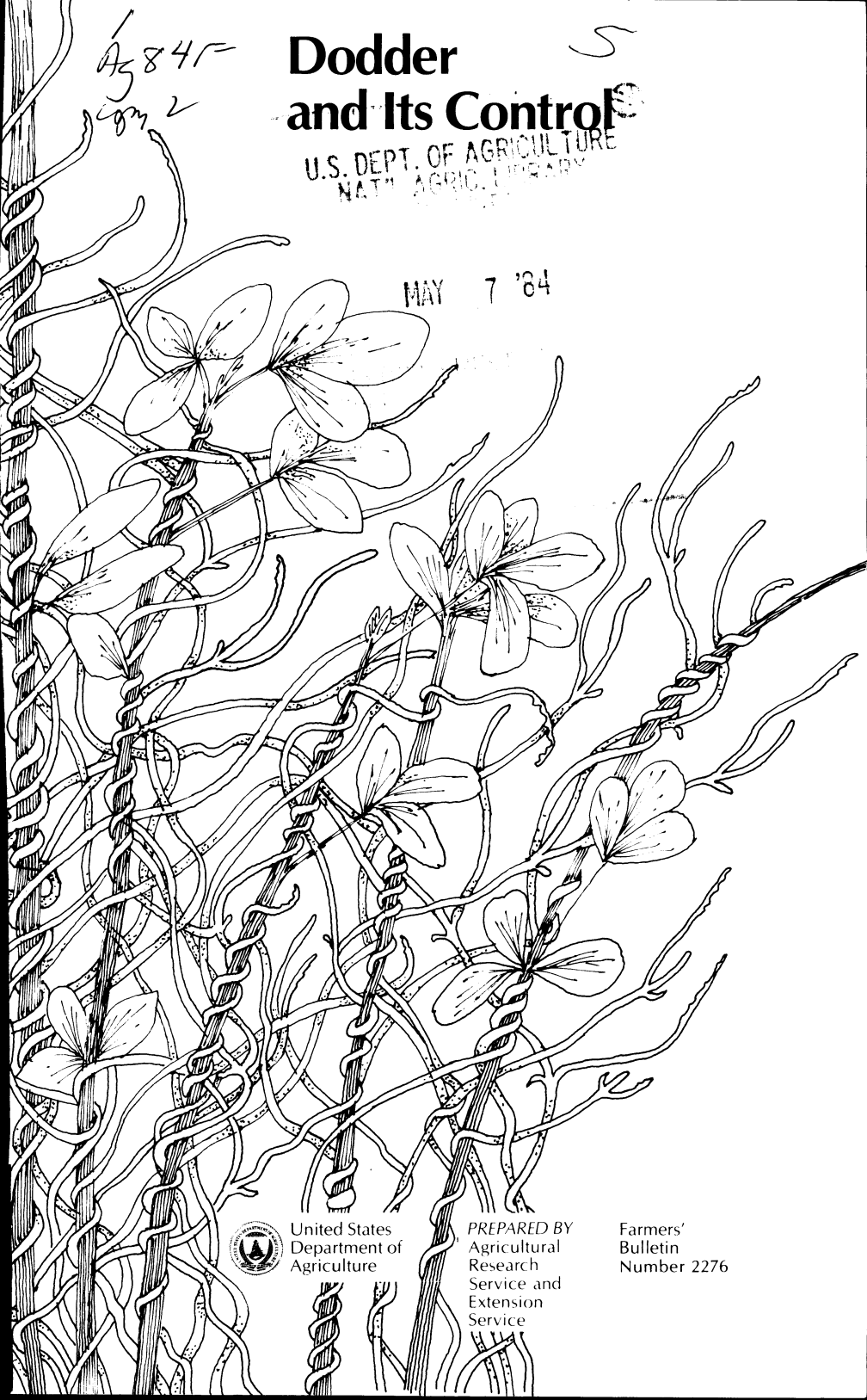
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Dodder and Its Control

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Agricultural
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Farmers'
Bulletin
Number 2276

Contents

Introduction	1	Controlling Dodder	11
Dodder Species	2	Scattered Patches	11
Characteristics of Dodder	2	Spot Treatments	12
Dodder Seed	2	Flaming	12
Dodder Seedlings	2	Cutting	12
The Dodder Plant	4	Contact herbicides	12
How Dodder Is Dispersed	5	Burning	12
Crops Affected by Dodder	7	Heavy Infestations	12
Alfalfa	7	Tillage	14
Lespedeza and Clover	8	Dry Soil	14
Tomatoes	8	Shading	14
Carrots and Onions	9	Crop Rotations	14
Sugarbeets and Potatoes	9	Control of Broadleaf Weeds	15
Cranberries and Blueberries	10	Herbicides for Dodder Control	15
Ornamentals	10	Soil-Applied Herbicides	15
Flax	10	General-Contact Herbicides	15
Other Crops	11	Postattachment Applications	15
Weeds as Hosts for Dodder	11	Alfalfa	15
		Alfalfa for Seed Production	15
		Alfalfa for Forage Production	18
		Seedling Alfalfa	18
		Lespedeza and Clover	18
		Tomatoes	19
		Ornamentals	22
		Blueberries	22
		Cranberries	22
		Carrots and Onions	22
		Sugarbeets, Potatoes, Flax, and	
		Safflower	23
		Use of Pesticides	23

Cover illustration: Field Dodder in Alfalfa

This Farmers' Bulletin supersedes "Controlling Dodder in Alfalfa," Farmers' Bulletin No. 2211, revised November 1969 and slightly revised September 1971.

May 1984

Dodder and Its Control

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Introduction

Farmers have been contending with weeds on this continent since colonial days. Johnsongrass in southern cotton, mesquite in southwestern rangeland, Canada thistle in Great Plains grain crops, and bermudagrass in irrigated areas of the Western States are representative serious weed problems. These weeds are all typical, normal green plants that grow very much like crop plants do. Dodder is a completely different kind of weed. It is a parasitic seed plant that infests many crops and ornamentals.

Dodder, like many troublesome weeds, has different names in different localities. Common names in addition to dodder include love vine, strangleweed, devilsguts, goldthread, pulldown, devilsringlet, hellbind, hairweed, devilshair, and hailweed. Some species of the weed are called by names that refer

to the plants on which the weed lives; alfalfa dodder, clover dodder, and flax dodder.

Because it is a parasite, dodder cannot survive alone but must attach itself to a host plant to live beyond the seedling stage. Dodder is a serious problem in forage legumes, tomatoes, cranberries, and ornamentals. It can also be troublesome in other crops, including carrots, onions, sugarbeets, potatoes, blueberries, flax, and even citrus trees. Dodder reduces the yield of any crop it infests, but the greatest economic loss from dodder probably occurs in the production of alfalfa seed throughout the West, and in tomatoes in California.

In seed crops, dodder not only lowers seed yield and quality, it also interferes with machine harvesting and adds to the cost of cleaning the seed. As an indication of its seriousness, dodder is the only weed that is legally restricted as a contaminant in crop seed in each of the contiguous 48 States. Dodder continues to be a problem.

You can prevent dodder from getting onto your farm, or spreading from field to field, much more easily than you can eradicate it after it has appeared. Therefore, take every effort to prevent dodder from establishing itself. If you find dodder on your farm, set up a plan of attack and follow it carefully. Your plan should take into account whether the infestation is

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widespread, or in localized patches, and whether you should consider substituting a different cropping system to cope with the dodder.

This Farmers' Bulletin will help you to develop a plan to control dodder in several crops.

Dodder Species

There are many species of dodder. They look very much alike and are difficult to tell apart. Some parasitize only certain noncrop plants, and are of little economic importance. Others have wide host range and attack many crop species.

The three species of dodder that cause the most damage in the United States are: Largeseed dodder (*Cuscuta indecora*), field dodder (*C. campestris*), and smallseed dodder (*C. planiflora*).

Largeseed dodder attacks a number of crop plants, but is an especially serious problem in forage legumes. It is common in the West, rare in the East, and found occasionally in the South.

Field dodder, one of the most destructive of all dodders, resembles largeseed dodder during the vegetative stage of growth. It has a wide host range, and grows in most parts of the United States.

Smallseed dodder causes serious losses in alfalfa in the West, but is not found in the East. This small-stemmed species grows in smaller but denser patches than many other species. Smallseed dodder germinates at lower temperatures than the other two species, and therefore emerges earlier in the spring.

Characteristics of Dodder

Dodder Seed

Dodder seeds are gray to brown, irregularly round, finely rough in surface texture, and similar to seeds of clover and alfalfa in density. Seeds of largeseed and field dodder are similar in size to seeds of alfalfa and red clover. Seeds of smallseed dodder are about the same size as those of white clover. When dodder is allowed to grow to maturity on a suitable host plant, it produces abundant seed.

Most dodder seeds are hard (seed coat impermeable to oxygen and/or water), and germination is thereby inhibited. Therefore, only a small part of the total seed population in the soil germinates in any single year. Once a field is infested, a dodder problem can be expected each year for many years. The length of time dodder seeds will remain viable in soil is not known, but periods of 10 to 20 years may be possible. Field dodder under simulated tomato culture conditions in north central California lost their viability in about 5 years. Over 90 percent of the total germination recorded occurred during the first and second year after seeding.

Because dodder seeds gradually lose their dormancy with time as the seed coat becomes permeable to oxygen and water, there are always seeds able to germinate under suitable environmental conditions. Consequently, new seedlings may emerge throughout much of the growing season. However, most dodder seed germinates in the spring.

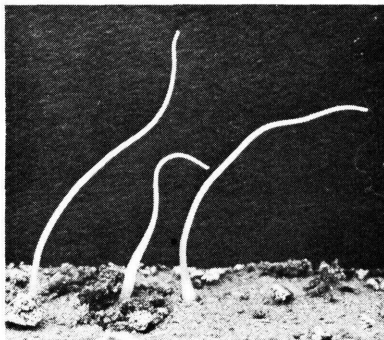
Dodder, unlike certain other parasitic plants, does not require stimulation from a host plant for its seed to germinate.

Dodder Seedlings

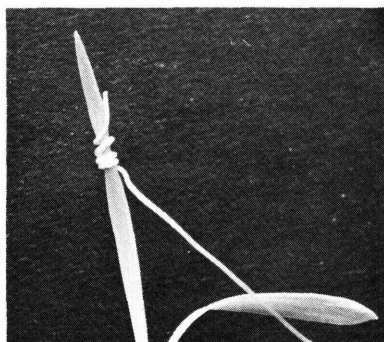
Dodder emergence has been recorded from depths as great as 4 inches in the soil; however, most



A dodder seedling consists of a rootless, leafless stem that emerges from the soil as an arch.



After emergence, the arch-shaped dodder seedling straightens out and begins to rotate counterclockwise.



The rotating dodder seedling twines indiscriminately about any elongated object it contacts. This dodder seedling will die because it has twined upon a grass plant, which is not a suitable host.

seedlings emerge from a depth of one-half inch. In heavy textured soils that tend to crack upon drying, dodder commonly emerges from the cracks.

Dodder seedlings are rootless and leafless, consisting simply of a fine, yellow, threadlike stem. They are usually 1 to 3 inches long and often hard to find. No part of the seedling extends deeper into the soil than the seed from which the seedling came. The lower end of the seedling can absorb water from the soil much as a root system would. Once the seedling has emerged, it seems to have little need for additional water. Thus the connection to the soil at this time probably serves more as an anchor point from which the plants rotate in seeking a host than as a source of water or nutrients.

Dodder seedlings usually attach themselves to host plants that are within 1 inch of their point of emergence. In most cases, if a suitable host plant is not within 3 inches of the dodder seedling, the seedling will die for lack of support. Dodder seedlings are succulent and do not dry out as rapidly as seedlings of green plants. However, hot, dry winds can kill seedlings before they attach themselves to the host plants.

Each seedling emerges as an arch, straightens out, and begins to rotate slowly, counterclockwise. On contacting any elongated object, the seedling twines about it. If the object happens to be the stem of a suitable host plant, dodder sends suckers (called haustoria) into it. The dodder seedling's direct connection with the soil then withers, and it lives completely at the expense of the host plant. If a dodder seedling fails to attach to a host plant, it will die.

The Dodder Plant

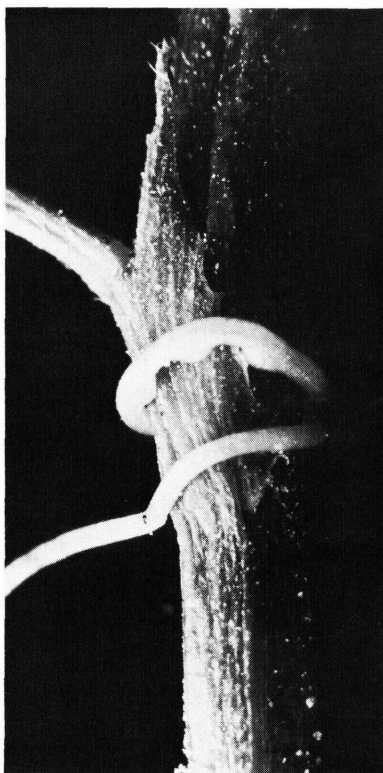
After attachment to the host plant, new shoots develop from the portion of the dodder seedling coiled about the host. These stems grow rapidly and reattach to other host plants, thereby assuring continued support for the parasite. Stem growth of 3 inches per day has been recorded. Largeseed and field dodder form tangled yellow mats through and on top of the crop plants. A single plant of these species may spread to a diameter of 10 feet or more during one growing season. Smallseed dodder does not become as large, but forms a very dense growth near the base of the crop plants.

Dodder is considered an annual plant. It usually completes its life cycle from a germinating seed to the production of mature seeds within one growing season. However, if the stems of the host plant in which dodder haustoria are embedded live over winter, the dodder haustoria can survive also.

After growing vegetatively for a period, dodder grows clusters of flowers which may be white, pink, or yellowish. The numerous flowers produce abundant fruit (capsules) that bear seed. These may fall to the soil, or be spread during harvest operations and, in seed crops, may contaminate the harvested seed.

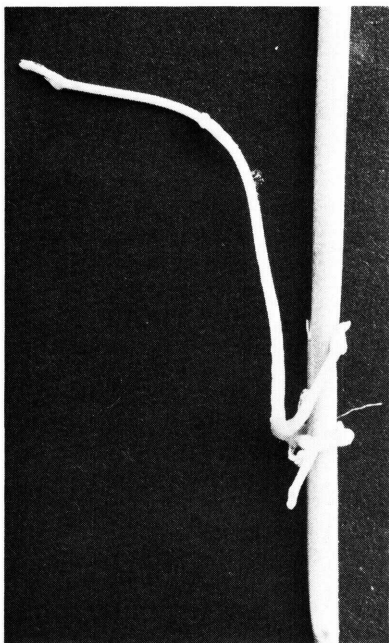
Largeseed and field dodder require open sunlight to grow best. When seedlings emerge from a soil shaded by dense crop foliage, attachment may be reduced more than 90 percent. Seedlings that do attach in shade grow and develop slowly. Dodder seedlings that cause the most trouble become attached when the crop plants are small, after a hay crop has been removed, or when open space between crop plants allows the soil to receive full sunlight.

The stems of dodder consist of nodes and internodes, just like



When dodder seedling twines about the stem of a suitable host plant such as this alfalfa, it produces haustoria, which penetrate the host. The direct connection with the soil soon withers, and the dodder lives at the expense of the host.

green plants. A tiny scale leaf is born at each node, and a bud within the axil of this leaf can produce a new dodder branch. The dodder reattaches itself to hosts at frequent intervals. Different dodder species differ in their method of reattaching. In some species, the main stem or its auxillary branches never twine, but continue to elongate in a straightforward manner. Such species bear tendrils at the nodes, but outside the leaf axils. Other species do not bear tendrils. In these species, the tips of the main



Dodder seedling recently attached to stem of alfalfa beginning to branch and spread. Dried up remnant of the original seedling is evident at right.

stem or its lateral branches twine.

The twined tendrils, stems, or seedlings of dodder contain cells capable of producing new shoots. A profusion of new branches can burst forth from the twined tissue where there are no organized buds. Twenty or more new dodder shoots can be produced from one tendril that is attached to a host plant. This accounts for the dense mat of stems that can develop.

The haustoria of dodder within the stems of the host plant also retain a high level of meristematic capacity. All external portions of the dodder plant can be completely removed from a host plant but the embedded haustoria will remain alive. They can generate new dodder plants as if they were buds of the host plant itself.

How Dodder Is Dispersed

Dodder reproduces and spreads principally by seed. Dodder seeds are heavy, and are not adapted for dispersal by wind or water, nor are they especially attractive to animals that could carry them from one place to another. Consequently, the major means of dispersal to new areas is by human activities. First of all, the parasite can be introduced to previously clean fields by planting crop seed contaminated with dodder seed. Then, by careless production activities, especially harvesting, seed produced on a farm can be dispersed about that farm or spread to another to increase infestation.

Dodder can also be spread from one farm to another by tilling or harvesting a dodder-infested seed field and then moving the equipment to another farm without cleaning it thoroughly. Manure or mud containing seeds may adhere to farm equipment, animals' hooves, or your shoes, and thus be carried from place to place. If hay containing dodder seed is fed to livestock, the weed may be spread because dodder seed can pass through the digestive tract of an animal and still germinate. Fields can be infested with dodder by spreading manure from animals that have eaten hay containing dodder seed.

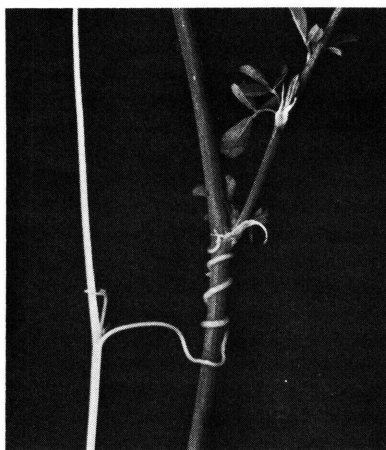
Uncontrolled dodder on fences and along roadsides can also infest fields. And, irrigation water may carry dodder seed from field to field.

Here are six steps you can take to prevent the spread of dodder:

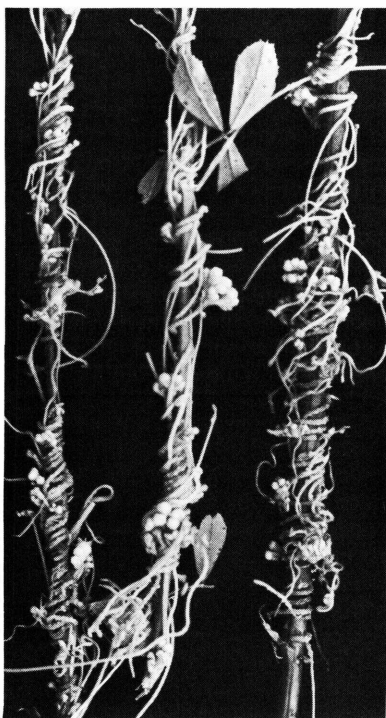
1. Do not sow crop seed that contains dodder seed. As far as possible plant only tagged, certified seed or other seed of known purity.
2. Before moving a combine or other farm equipment from a field known to be infested with dodder to one not known to be infested, clean the equipment thoroughly.



Field dodder spreading from original attachment of seedling on stem of alfalfa.



Terminal portion of shoot of field dodder whose tendril has reattached to stem of alfalfa. Such reattachment assures continued support of the dodder.



Stems of alfalfa heavily entwined by tendrils of field dodder and/or largeseed dodder. Twining is always counterclockwise.

3. If you feed hay containing dodder seed, confine the animals to a feedlot, to the field where the hay originated, or to a field where susceptible crops are not likely to be grown. Forage crops infested with *immature* dodder can be harvested with a field chopper, to be dehydrated and made into alfalfa meal or to be fed green or as silage, without danger of spreading viable dodder seed.

4. On dodder-free land, do not spread any manure that you suspect contains dodder seed.

5. Do not allow dodder to grow along irrigation ditches where water could carry the seed from place to place.

6. Do not allow dodder to grow on fence rows or along roadsides.

Crops Affected by Dodder

Alfalfa

A heavy infestation of dodder in alfalfa seed fields can destroy the crop. If the alfalfa is heavily infested at the time of flowering, most of the flowers fall from the plant and few seeds are set. The seed that is set on infested plants tends to be small, shriveled, and of low quality. The presence of dodder seed in alfalfa seed greatly reduces the value of the crop. It normally prevents certification, and therefore makes the dollar value of the seed lower. Usually, intense efforts are put forth to remove dodder seed from alfalfa seed, and in so doing a considerable amount of good alfalfa seed is lost in the process. Dodder also makes it difficult to harvest alfalfa seed, because the succulent dodder stems do not dry well, and the wet sticky material interferes with the operation of the combine.

The culture of alfalfa for seed production favors the growth and development of dodder. Because

alfalfa is not cut frequently, dodder can complete its life cycle and produce mature seed without being disturbed.

Dodder is normally less troublesome in alfalfa grown for forage than for seed production. The frequent cutting of hay disrupts the growth of dodder, and reduces the production of dodder seed. Dodder depresses the growth of alfalfa hay, but not to the extent that it interferes with the production of seed. The warmer the climate, the more serious is the dodder problem in alfalfa grown for hay. In the irrigated desert areas of southern California and Arizona where 7 to 10 cuttings of alfalfa per year are harvested, dodder can be extremely destructive in alfalfa hay fields. Dodder thrives in the intense heat of summer in these areas. Because there are so many cuttings during the prolonged warm period, dodder continues to proliferate from one cutting to the next before cool weather reduces its growth. Alfalfa itself grows less vigorously during extreme heat than it does at cooler temperatures. Therefore it is affected even more by the growth of dodder than it would be if it were growing under more favorable conditions.

Lespedeza and Clover

Dodder is a major problem in the production of lespedeza in the Southeastern United States. It occurs as an occasional infestation, rather than as a widespread weed. Dodder prevents normal growth and development of the lespedeza plant, thereby considerably reducing forage and seed yields. Of greater significance is the problem dodder causes in lespedeza seed production. Because of stringent requirements against dodder in certified seeds, it is particularly undesirable in seed fields.

Depending upon soil temperatures, lespedeza usually begins

germinating in late March and continues through mid-April. Regrowth of established stands of perennial lespedeza begins in early spring after the last killing frost. Moisture, temperature, and date influence the development of dodder in lespedeza. Usually, dodder germinates slightly later than lespedeza or after regrowth of established stands begins so that dodder can attach itself to the host plant.

Dodder grows slowly when first attached on lespedeza in the early spring. However, it grows rapidly when the temperature rises. As the season progresses, dodder spreads throughout the lespedeza. Indeed, there is a direct correlation between dodder's germination and growth and that of lespedeza's. If dodder attachment or early growth can be delayed, the problem of dodder in lespedeza production can be reduced.

While lespedeza grows well under most conditions in the Southeastern United States, even during drought, dodder likewise grows well under these same conditions. Indeed, the growth of dodder appears to be relatively unaffected by most weather changes during its growth period. Once established in lespedeza used as a grazing or hay crop, dodder is exceedingly difficult to eliminate. When lespedeza is not available as a host, many common weeds serve as suitable alternate hosts. These weed hosts may include ragweed, horse nettles, and citrons. As a result, dodder frequently can be found in lespedeza plantings made with dodder-free lespedeza seed.

Tomatoes

Dodder infestations reduce tomato yields and, if allowed to produce seed, dodder makes the land unsuitable for producing tomatoes or other susceptible crops. The optimal environmental conditions for seed

germination and growth of field dodder and those for tomatoes are similar. Once a dodder seed germinates, the seedling readily attaches to the tomato plant and can spread many feet along the tomato row. Dodder seedlings will parasitize tomatoes at any stage of growth and cause significant damage. However, dodder is particularly serious in direct-seeded tomatoes when dodder attaches when the tomato plant is at the cotyledonary stage or has only developed one or two true leaves. If parasitized at these early stages of development, the tomato may not survive. Larger tomato plants are usually not killed when attacked by dodder but yields are reduced.

Dodder can be detrimental to both fresh market and processing tomatoes. However, it is more serious in processing tomatoes because larger growing areas are involved and it is difficult to apply optimal control methods to those areas. Furthermore, in processing tomatoes, the increased use of mechanical harvesting equipment and associated mass production techniques favor the spread of dodder seed from infested fields to noninfested fields. Because mechanized tomato production requires a large investment in crop-specific equipment, crop rotation with nonsusceptible crops is often limited. This aggravates the dodder problem, because crop rotation is one of the best ways to control dodder.

At one time, the increase of dodder in tomatoes was considered to be associated with dodder seed contamination of the crop seed because most of the processing tomato seed used in the United States is produced abroad. Dodder is indigenous to several of these seed producing areas. However, an extensive survey of commercial tomato seed lots by the California

Department of Food and Agriculture did not detect the presence of dodder seed. Therefore, it seems unlikely that tomato seed is a significant source of dodder infestations in tomatoes.

The main source for the spread of dodder in tomato-producing areas appears to be from inadequate decontamination of equipment used for land preparation, cultivation, herbicide treatment, and harvesting before this equipment is moved from dodder-infested fields to noninfested fields. Other methods of dodder dispersal previously discussed are also applicable to tomatoes but are relatively less important.

Field dodder appears to be the major dodder species parasitizing tomatoes.

Carrots and Onions

Dodder is rarely a major problem in these crops where appropriate crop rotation is practiced as long as the crops are not planted in heavily infested fields. Onions appear to be more susceptible to parasitism by dodder than carrots. However, severe dodder infestations have occurred in both crops with associated yield reductions and harvesting problems.

Sugarbeets and Potatoes

Sugarbeets and potatoes are very favorable hosts to dodder. Dodder seems to grow especially well on potatoes. Both of these crops are commonly grown in rotation with alfalfa in irrigated areas of the Western States. Severe dodder problems often occur in these crops when they are planted the year after rotating out a crop of alfalfa that was heavily infested with dodder. Dodder is seldom a threat to sugarbeets and potatoes grown in the cooler areas such as Montana, the Red River Valley, or Maine.

Cranberries and Blueberries

Dodder can cause severe losses in both cranberries and blueberries, particularly in the warmer areas of production. Dodder can form a solid mat over the top of cranberry vines. Yields in the infested area are greatly reduced and in a few years, dodder can kill the cranberry vines.

Changes in the culture of cranberries in recent years have increased the potential threat of dodder. Harvesting methods have changed from dry harvesting to water harvesting in many areas. Water-harvested bogs are flooded and the berries are either knocked off the vines with a mechanical beater or raked off. Either method disperses the dodder seed in the flood water. This not only spreads the seed in that bog, but as this flood water is reused in the harvesting of other bogs, dodder is spread from bog to bog.

The use of sprinkler irrigation, another change in culture in recent years, also spreads dodder in cranberry bogs. Water is applied through sprinklers for irrigation, for frost protection, and to cool cranberry plants when the temperature is too high. Thus, cranberry bogs may be sprinkler irrigated over much of the growing season. Dodder seed can be spread through the irrigation system if the water is contaminated from dodder either growing along the banks of reservoirs or along the canals feeding the reservoirs.

Dodder can often completely cover blueberry bushes. Not only does dodder reduce yields, it can kill the bushes. The portion of the bush above the densely twined tendrils of the dodder is almost always killed. Dodder tends to blossom profusely at these "collars." This infested portion of the bush must be

cut out and removed from the field to prevent production of abundant dodder seed. The cultural practice of cultivating blueberries both in the fall and the spring disperses dodder seed through the field.

Ornamentals

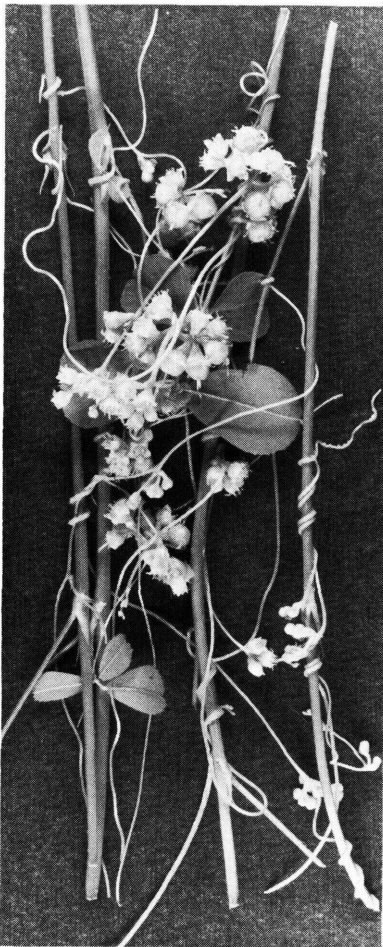
Dodder is not usually a problem in commercial ornamental crop production growing areas. Ornamental growers use steam sterilization or effective chemical soil fumigants to treat growing media mixtures before planting crops in either containers or ground beds. These methods are also used for greenhouse and field production.

An infestation of dodder may occur in established home or commercial landscape plantings. Under landscape conditions, dodder infests a wide range of woody and herbaceous ornamental plants. Some of the species which appear most susceptible to a dodder infestation are chrysanthemum, dichondra, pachysandra, several hederia species, various oaks, ixora, and citrus.

Field dodder appears to be most common on ground cover ornamentals in California while largeseed dodder is the most widely reported problem species in Florida landscapes. Both of these species are also found in the Northeastern United States. Many of the dodder species reported in the United States can affect a variety of herbaceous shrubs and woody plants.

Flax

The small stature and limited shade provided by flax plants favor the growth of dodder. Dodder can be a serious problem in flax grown in warm climates. In Northern States (North Dakota and Minnesota), temperatures do not favor dodder development.



Stems of alfalfa taken from a heavy infestation of field dodder in late bloom stage.

Other Crops

Numerous other broadleaf crops may be parasitized by dodder. The authors have observed dodder infestations on hops, peppermint, safflower, peppers, and tobacco.

Weeds as Hosts for Dodder

Some species of dodder that infest crop plants also have a large number of hosts among wild shrubs and herbs. These include field bindweed, Russian thistle, chickweed, willow, aster, sagebrush, goldenrod, ragweed, nettle, purslane, pigweed, sunflower, wild carrot, shepherds-purse, dandelion, viburnum, marshelder, and horsenettle. Dodder seedlings often attach first to weed seedlings, then spread to crop plants. General weed control therefore helps control dodder. Even if susceptible crops are not being grown on a dodder-infested field, dodder can grow on weeds, and add dodder seed to the soil.

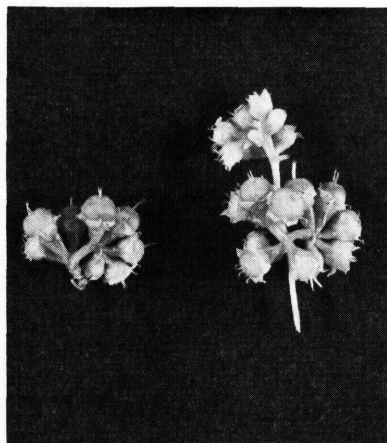
Nonhost crops such as corn or wheat are often grown on dodder-infested soils to reduce the quantity of viable seeds in the soil. In this cropping system, you must control all broadleaf weeds to deprive the dodder of all host plants. See CROP ROTATIONS, on page 14.

Controlling Dodder

Scattered Patches

Dodder commonly appears first on a farm as scattered patches. If you take stringent measures to destroy this initial infestation, you can usually prevent an expensive, widespread infestation. At present, there is no satisfactory method for destroying attached dodder selectively. To control such patches of dodder, you have to destroy the parasite and the host plant on which it is growing to a point below the attachment site. Only use this method if the infestation of dodder is small enough that the resultant loss of crop does not exceed the value of controlling the dodder.

As the first step in controlling a scattered infestation, go over the



Clusters of fruit (capsules) of field dodder.

whole field, locate the patches, and mark them. Use one of the following spot treatments, and, in dense-growing crops like alfalfa and lespedeza, treat several feet beyond the apparent edge of each patch to be sure you kill all the dodder. Revisit the field at 2-week intervals to find any new patches, and to be sure no dodder has survived in the treated patches. Place a permanent marker in each patch so it can easily be checked in subsequent years.

Spot Treatments

You can control scattered infestations of dodder by flaming, by cutting, by applying contact herbicide, or by burning. Combinations of these methods are usually best.

Flaming. Weed burners fueled with propane or butane are effective for flaming patches of dodder. For best results, kill the topgrowth with a light flaming, and then several days later when the vegetation has dried, burn the patches.

Cutting. If you cut the host plants below the point at which the dodder is attached, the dodder will die. Remove the cut vegetation from the field in sacks to be destroyed, or

leave it in place to be burned after it has dried.

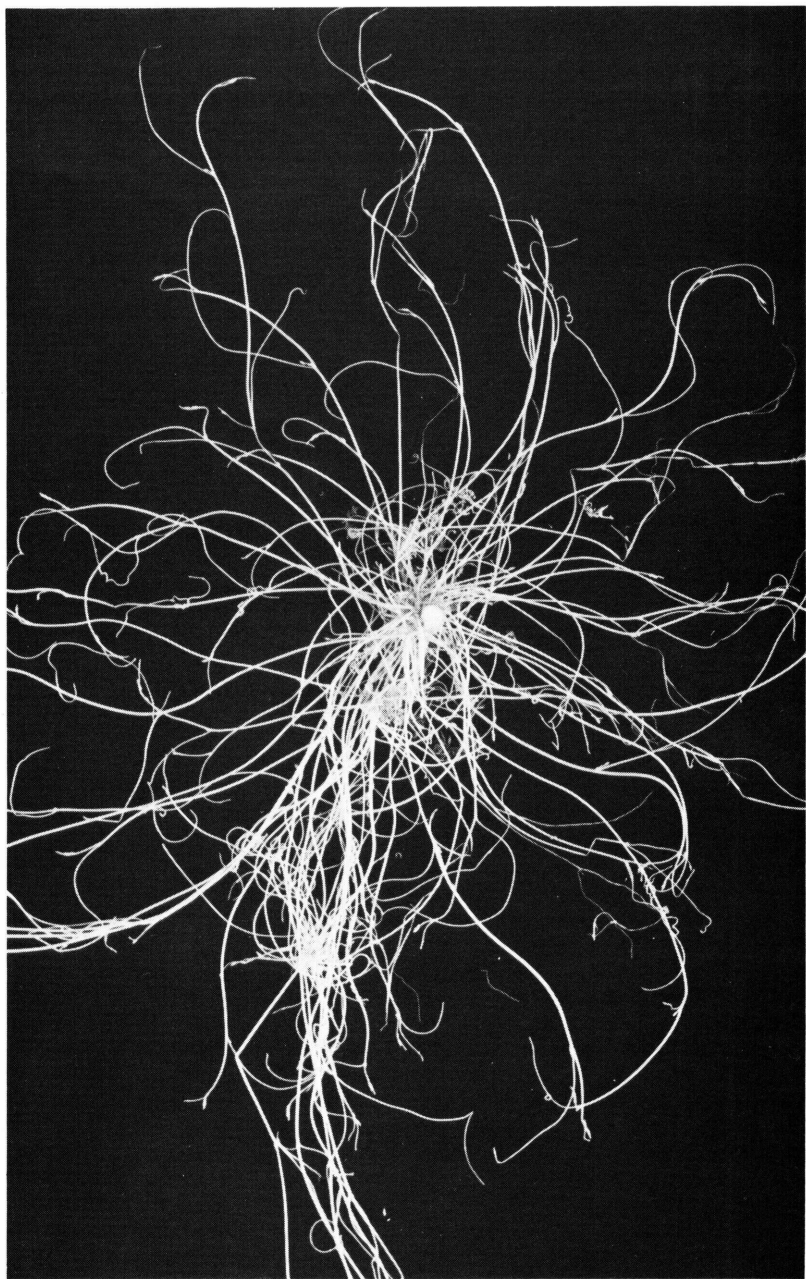
Contact herbicides. Spray general-contact herbicides such as dinoseb or paraquat on dodder patches to kill the vegetation. Contact herbicides often do not completely destroy the heavy woody basal stems of the host plants in which some dodder haustoria are embedded. Thus, you may not be able to destroy dodder patches with one application of a contact herbicide. See HERBICIDES FOR DODDER CONTROL on page 15.

Burning. The final destruction of a patch of dodder is usually accomplished by burning the area completely black. The burning process is usually preceded by flaming, cutting, or applying a contact herbicide. This kills most of the plant tissue and allows it to dry out so it will burn. Because dead material often does not supply sufficient fuel for a good fire, add diesel oil or dry straw, or use a propane flamer to consume the dry material.

Heavy Infestations

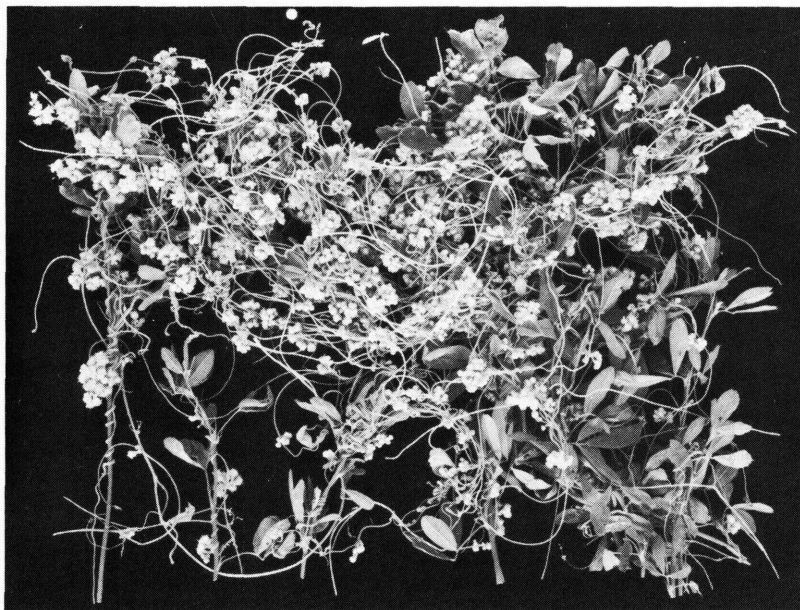
When a field has too much dodder for spot treating, you must treat the whole field. Unlike spot treatment, in which the host plant and the dodder are destroyed together *after* the dodder is attached, widespread infestations require selective methods that kill dodder seedlings *before* attachment. Because dodder usually continues to emerge as hard seeds germinate throughout the spring and summer, you must provide control during a period of several months each season.

Overall control is based on mechanical, chemical, and cultural methods. Available methods seldom control 100 percent of the dodder. However, if you apply these methods precisely and diligently, you can achieve a level of control



Abundant shoots of field dodder that developed from one seedling attached to an isolated flixweed (*Descurainia sophia*) plant. The single-stemmed, upright growth of the host and the

absence of other nearby host plants prevented reattachment of the tendrils. The shoots radiating like the spokes of a wheel are evident after the root and upper stem of the host have been cut off.



Alfalfa heavily infested with field dodder.

even on heavily infested fields so that patches from individual plants that escape control can be destroyed by spot treatment.

Tillage. Because they are rootless, dodder seedlings are easily dislodged from the soil by tillage. Seedlings die if they are buried or become dry, although dodder does not dry out as readily as many other plants. Therefore, use repeated tillage to assure that no seedlings survive to attach to the host plants.

Dry Soil. Seeds of dodder do not germinate in dry soil. The soil surface usually dries between rain showers or applications of irrigation water. Use shallow tillage to hasten soil surface drying. If you irrigate, irrigate at infrequent intervals. A period of dodder control can result simply because dodder seeds do not germinate in dry soil.

Shading. Dodder requires sunlight to attach to host plants and to grow normally. The shade from a crop such as alfalfa can suppress dodder sufficiently to control it, especially during the time of the year when a

heavy crop cover is present. The combined effect of dry soil and shading can provide an important part of a total dodder control program. However, this method of control is of little or no value if dodder has escaped control earlier when the soil was moist, and the crop was not large enough to provide shade.

Crop Rotations

Dodder and certain other parasitic weeds are perhaps the only major weed problems that can be controlled completely simply by crop rotation. Dodder will not parasitize any member of the grass family. Plant corn, cereal grains, or forage grasses on dodder-infested soil. If you keep such crops free of broadleaf weeds that would serve as hosts for dodder, no dodder can grow and produce seed. Dodder seeds in the soil germinate but the seedlings die. Two or more years of a grass crop can significantly reduce the reservoir of dodder seeds in the soil.

Control of Broadleaf Weeds

Various species of dodder parasitize many species of broadleaf weeds. The dodder seedlings that parasitize crop plants frequently attach first to seedlings of broadleaf weeds. Once attached, the growing dodder may reach the crop plant and parasitize it. Broadleaf weed control is almost always profitable. But where a dodder problem exists, you can also reduce the infestation of dodder by controlling these weeds. Without access to the weedy hosts, many dodder seedlings die because they lack the growth potential to reach a crop plant.

Herbicides for Dodder Control*

Soil-Applied Herbicides

Dodder is very difficult to control selectively once it has become attached to the host plant. Therefore, herbicides applied to the soil that kill the dodder seedlings before they become attached to a host plant are most effective. Various soil-active herbicides will control dodder. The materials which have been used most for dodder control are chlorpropham, DCPA, pro-namide, CDEC, and dichlobenil. These herbicides will control dodder selectively in many crops.

General-Contact Herbicides

Certain herbicides that destroy any soft plant tissue on which they are sprayed can be used to kill dodder. Such materials also kill the exposed portion of the host plant, and destroy the productivity of the current year's crop. Thus these herbicides can be considered selective

only because they do not kill the root system of perennial crops. Dinoseb and paraquat are the herbicides most commonly used for contact destruction of dodder and its supporting host.

Postattachment Applications

After dodder is attached to the host plant and growing rapidly, it is very difficult to control selectively. Certain experimental herbicides will kill the exposed portion of dodder plants selectively in some crops. Recent research has demonstrated that DCPA¹ at 10 lb/A and glyphosate at 0.07 lb/A can kill the exposed portions of dodder selectively in alfalfa. Unfortunately, some of the embedded dodder haustoria survive and allow the dodder to regenerate itself after all visible external dodder has been destroyed by such an application.

Alfalfa

There are three separate and distinct situations with respect to dodder control in alfalfa. These are (a) established alfalfa grown for seed, (b) established alfalfa grown for hay, and (c) alfalfa seedlings. Dodder control in alfalfa for seed production is further complicated because alfalfa seed may be grown as the only crop of the season (first crop seed), or a crop of hay may be harvested before the seed crop is produced (second crop seed).

Alfalfa for Seed Production. In areas such as the Pacific Northwest, dodder must be controlled for about 4 months each year to assure full-season dodder control. In California or Arizona, a longer period of control is required. Unfortunately, the herbicides available for dodder control tend to be shortlived in the soil. Therefore, one or two applications of the herbicide do not provide a sufficient period of control. Other cultural and mechanical methods of control must be used together with herbicides to have a satisfactory full-season control program.

*All application rates are expressed as active ingredients (a.i.).

¹DCPA and glyphosate are not federally registered for application to alfalfa foliage at this time. Current use limitation of DCPA is mentioned in footnote on page 16.



Tomato infested with dodder (left) or uninfested (right).

If you do not harvest a hay crop as the first crop of the season, you can control dodder for 4 to 6 weeks in early spring by intense tillage. For good control, till frequently enough to kill dodder seedlings before they become attached to host plants. Use such implements as the skew treader, finger weeder, tine-tooth harrow, or any combination of these tools. Such tillage usually does not damage alfalfa permanently, but it does retard growth of the foliage. Therefore, do not use tillage where a hay crop is to be harvested before the seed crop.

You may use four soil-applied herbicides to control dodder in alfalfa grown for seed production.

²DCPA is not federally registered to control dodder on alfalfa. It does have a number of intrastate registrations for this use pattern which have EPA accession numbers and are subject to EPA reregistration at any time. Registrations are now limited to the States of Colorado, Idaho, Nevada, New Mexico, Oklahoma, Oregon, Washington, and Utah.

These are chlorpropham, DCPA², dichlobenil, and pronamide. Chlorpropham at 6 lb/A and dichlobenil at 2 lb/A usually control dodder for about 4 weeks, and DCPA at 10 lb/A and pronamide at 1.5 lb/A control dodder for 4 to 8 weeks. One application of any of these materials does not provide control long enough for a full season. Therefore, apply the herbicides twice, together with tillage and other management practices.

Chlorpropham is usually applied as a granular formulation. It is most effective when applied while the soil surface is wet from recent rainfall or irrigation, and just as the dodder is emerging. Because of its short soil persistence, delay applying chlorpropham as long as possible to realize maximum benefit. Chlorpropham is also effective if applied on the surface of dry soil followed by irrigation.

In first crop seed, apply chlorpropham twice at monthly intervals. A typical schedule in the Pacific



Northwest would be to apply the herbicide April 20 and May 20 following a period of periodic tillage beginning in mid-March. For second crop seed, the first application would be made in mid-April. It would be applied the second time in late May following the harvest of the hay crop. Because alfalfa tolerates chlorpropham well, you may use it without injuring the crop.

Chlorpropham applied as a granular formulation on the soil surface kills newly emerged dodder seedlings above ground by vapor contact. To favor the accumulation of a lethal concentration of vapors near the soil surface, alfalfa must be at least 6 inches tall when the herbicide is applied. This reduces wind movement at the immediate soil surface and allows the herbicide vapors to contact the dodder seedlings.

³See current use limitation mentioned in footnote on page 16.

The insecticide carbaryl inhibits the decomposition of chlorpropham in soil. It does not affect dodder directly but can prolong the period of dodder control from chlorpropham. Liquid formulations of chlorpropham and carbaryl are mixed in the spray tank and applied together to the soil before dodder emerges.

DCPA³ is registered in several Western States for use in alfalfa grown for seed only. Apply DCPA before many dodder seedlings emerge. If you apply DCPA too early, you will waste a portion of its period of control. DCPA is most effective when followed shortly after application by rainfall or overhead irrigation.

DCPA has some systemic activity, and sometimes controls dodder that is already attached. Such postattachment activity has not been consistent, therefore the herbicide is most effective when applied before dodder has attached to the host plant.

Pronamide is most effective when applied early in the spring and moved into the soil by rainfall, overhead irrigation, or light tillage.

Dichlobenil is currently more expensive than DCPA or chlorpropham. When applied at 2 lb/A, control from dichlobenil is similar to that from chlorpropham applied at 6 lb/A. In addition to controlling dodder, dichlobenil controls almost all weeds coming from seed, and it also inhibits certain important perennial weeds such as quackgrass, field bindweed, and Canada thistle after they are established. Because of its cost, dichlobenil is usually used for dodder and its control only when the benefit from its activity against perennial weeds can also be realized. When dichlobenil is applied to alfalfa, some of the leaves turn yellow or purple, and the stems become somewhat brittle, but seed yields are not normally reduced.

You can increase the level of dodder control by using combinations of herbicides. A reduced rate of chlorpropham applied with a full rate of DCPA⁴ frequently gives outstanding control. Similarly, a reduced rate of dichlobenil applied with either chlorpropham or DCPA increases dodder control and controls many other weed species as well. Although expensive, a 3-way combination of DCPA at 10 lb/A, chlorpropham at 3 lb/A, and dichlobenil at 1 lb/A controls dodder and nearly all other weeds effectively without appreciable effect on the established alfalfa.

If you control dodder by early tillage and then use herbicides, alfalfa normally grows dense enough to control dodder by shading. Under irrigated conditions, you can usually manage irrigation so that the soil surface is dry when the effectiveness of the herbicides has dissipated. By delaying the next irrigation, you can extend the period of dodder control, because no additional dodder germinates until the soil is moistened again. Under Pacific Northwest conditions, any dodder that emerges after the first day of August simply does not have time to become troublesome before seed harvest.

Alfalfa for Forage Production. For dodder control in alfalfa grown for forage, the possibilities of control are fewer than they are for seed production. Dichlobenil and DCPA are registered for use in alfalfa for seed production only (1981). Therefore, these materials are not available for dodder control in forage alfalfa. Moreover, controlling dodder by tillage is less feasible in forage than in seed production. Any tillage damages the young shoots of alfalfa coming from the crown and delays growth. Consequently, controlling dodder by tillage in forage alfalfa reduces crop yield.

Chlorpropham is presently the only herbicide available for controlling dodder in alfalfa grown for hay production. Apply it in the same manner already described for seed production, and apply it for control in all except the last two cuttings of the season.

When forage alfalfa is severely infested with dodder, consider rotation to nonsusceptible crops as an effective control measure.

Seedling Alfalfa. Whether grown for seed production or forage production, seedlings of alfalfa are extremely susceptible to damage by parasitism from dodder. Spring-seeded alfalfa can be killed if dodder parasitizes it early in the year. Normally, alfalfa should not be seeded in soil infested with dodder. However, if seeding is warranted because an area is especially well suited for seed production, alfalfa can escape damage from dodder if you seed at the proper time.

Alfalfa seeded in late summer or early fall can escape the harmful effects of dodder and no herbicides are needed to protect the alfalfa. In Washington State, alfalfa seeded in late August or early September in soil heavily infested with dodder was not injured. Abundant dodder became attached to the alfalfa seedlings, but the ensuing cool weather inhibited its development, while the alfalfa seedlings continued to grow into the late fall. When freezing weather eventually killed the topgrowth of the alfalfa, all the dodder was killed also. When the alfalfa resumed growth the following spring, the alfalfa was large enough to tolerate dodder control treatments for established alfalfa.

Lespedeza and Clover

Crop losses from dodder infestation in these crops are usually low because dodder occurs only sporadically. Although production losses are low, dodder is particularly undesirable in seed-producing areas.

⁴See current use limitation mentioned in footnote on page 16.



Blueberries heavily infested with dodder.

Because dodder usually occurs in patches in infested areas, most research has been directed toward controlling the weed in established stands of lespedeza and clover. The most effective registered herbicide is chlorpropham applied in late spring before dodder germinates. This herbicide provides early season control of most grass weeds and some small-seeded broadleaf weeds as well as dodder. Use 4 lb/A of chlorpropham.

Because this herbicide is relatively shortlived in the soil, delay application as late in the spring as possible but apply it before dodder emerges.

You may treat isolated patches of dodder with a foliar active herbicide. Use paraquat; 2, 4, -D; or dinoseb for this purpose. These herbicides will injure lespedeza and clover, consequently you sacrifice the crops in the treated areas.

Except in unusual situations, treatment can be justified only in seed fields. Even then, a more practical approach would be to select noninfested areas for seed production.

Tomatoes

The best ways to control dodder in tomatoes are to prevent the initial invasion and to control scattered patches before the dodder plant produces seed. The preventive control methods previously discussed are extremely important and cannot be overemphasized. Use them together with selective chemical control methods for heavy infestations as long as you produce tomatoes or other susceptible crops on dodder-infested land. In this way you minimize reinfesting the land with dodder seed. Follow this procedure because selective chemical control methods are never complete



Dodder infesting petunias.

and all of the dodder seed in the soil does not germinate in any single year.

Two soil-applied herbicides, CDEC and pebulate, control dodder selectively in tomatoes. Pebulate probably reduces the dodder infestation most by controlling broadleaf weeds that could serve as the initial attachment site for the dodder. CDEC controls dodder directly. Both can be applied as a preplant, soil incorporated treatment in direct-seeded or transplanted tomatoes. The depth of soil incorporation should be about 2 inches. Power-driven rotary tillers work best; however, cross-disking or other means of soil incorporation have been used. Cultivate between the rows to control broadleaf weeds and dodder before the dodder attaches to the crop. You can apply CDEC as a preemergence treatment followed by sprinkle irrigation or rainfall. Pebulate is too volatile to be applied in this way.

At rates of 4 to 6 lb/A, these herbicides control dodder from 6 to 8

weeks. Use the lower rate on light soil low in organic matter and the higher rate on heavy soil. Slight stunting of tomato seedlings on lighter soils occasionally occurs. If the treated soil is not disturbed or untreated soil is not placed on top of the treated area, almost season-long control can be expected in the treated areas. Generally, CDEC gives somewhat better control than pebulate. However, pebulate is usually more effective than CDEC for controlling other annual broadleaf weeds and grasses in tomatoes. Combinations of these two herbicides have been used. CDEC and pebulate are also combined with other tomato herbicides to broaden the spectrum of weeds controlled.

A third herbicide, chlorpropham, can be used to control dodder in *established* tomatoes. Apply chlorpropham at 4 lb/A before dodder emerges as a granular formulation or as a spray directed to the base of the tomato plants. Do not apply chlorpropham in direct seeded



Dodder infesting periwinkle.

tomatoes to control dodder that emerges with the tomatoes because it will injure the tomatoes.

You can apply DCPA at rates of 4.5 to 10.5 lb/A in tomatoes 4 to 6 weeks after transplanting or on direct-seeded plants 4 to 6 inches high before dodder seed germination. DCPA is usually directed to the soil, but it may also be applied over the top of transplants.

Ornamentals

Dodder often invades home landscapes where chemical weed control methods are not usually practiced. If you have this condition, remove the dodder and the host material to which it is attached by hand and destroy both promptly.

In commercial or industrial landscapes, use DCPA at 10 lb/A, chlorpropham at 6 to 8 lb/A, or dichlobenil at 4 to 6 lb/A before dodder emerges. These compounds should only be used for dodder control in plantings of established ornamentals which are not susceptible to herbicide injury.

Blueberries

Dodder control in blueberries is difficult because the dodder seed germinates over a long period of time. You will need an integrated weed control program. Use cultivation as well as preemergence and postemergence herbicides.

Cultivate the area beneath the bushes with a rotary hoe to remove all weeds before applying any herbicide. Start a basic herbicide program to control the broadleaf weeds that may serve as alternate hosts. Then, superimpose over this basic herbicide program additional herbicide treatments specifically for dodder.

You can use both dichlobenil and chlorpropham for preemergence dodder control in blueberries. Neither of these herbicides offers more than 4 to 6 weeks control, so delay applications as long as possible. Only the area beneath the

bushes needs the additional treatment.

If dodder germinates after the effective period of the preemergence herbicide, cultivate the area or treat it with the postemergence herbicide paraquat. If paraquat is used, treat the dodder before it becomes attached to the blueberry bush because paraquat must not contact the blueberry leaves.

Cranberries

Dodder is difficult to control in cranberries because cranberries grow on vines and you cannot cultivate them. Thus, preventive measures are important.

Remove any dodder from the banks around the cranberry bogs, reservoirs, and canals by mowing and spot treating the areas with herbicides. If dodder becomes established in a bog, do not allow it to produce seed. Remove the dodder, especially the flowers and seed pods, by hand to prevent dodder from spreading within the bog. Mark the areas infested with dodder so that they can be treated before the dodder germinates the following year.

You can use two herbicides to control dodder in cranberries: chlorpropham and dichlobenil. Both of these herbicides have restrictions as to when they can be applied to cranberries. You can apply chlorpropham only when the cranberry plant is dormant. The residual effect of chlorpropham is limited to 4 to 6 weeks. You can apply dichlobenil up to the time the cranberry blooms. For the best control, apply chlorpropham in early spring, and then apply dichlobenil just before the cranberries bloom. In severe cases, you may have to take an infected area out of production and treat it on a monthly schedule with dichlobenil and/or chlorpropham.

Carrots and Onions

The key to controlling dodder in these relatively short-season

vegetable crops is prevention—prevention by appropriate crop rotation, by using uninfested fields, and by treating scattered patches. Heavy infestations require treatment of the entire field with a selective herbicide. You must anticipate these heavy infestations because the herbicides used only control dodder as it germinates, prior to attachment.

Chlorpropham, which has been used extensively for dodder control in alfalfa, is also registered for use in carrots and onions. Apply it to the surface of the soil at rates of 4 to 6 lb/A. In carrots, use the lower rate on clay loam soils and the higher rate on heavy dark mineral or muck soils but apply it before the crop emerges.

In onions, use the lower rate on heavy dark mineral soils and the higher rate on muck soils. You can apply chlorpropham to onion sets or direct-seeded onions before the crop emerges or up to the early loop stage for seeded onions. You can also use chlorpropham after the onions are 6 inches high and have three or more true leaves. Use a directed spray which only contacts the lower 1 to 2 inches of the onions. Do not apply chlorpropham to direct-seeded onions during the flag stage as injury to the crop may result.

Crop injury may also occur in these crops when chlorpropham is used on light colored or sandy soils. The manufacturer does not recommend the use of chlorpropham for use in carrots and onions in California.

DCPA, applied at rates of 4.5 to 10.5 lb/A, can be used in onions at seeding or transplanting time and/or at layby before dodder seed germinates. You may apply DCPA to the soil surface or you can spray it directly over transplants.

Sugarbeets, Potatoes, Flax, and Safflower

Very little research has been conducted concerning dodder control

in these crops. Because these crops are susceptible to parasitism by dodder, do not seed them in heavily infested fields. Where dodder seed is present in the soil, grow grass crops for 2 or more years before susceptible crops are planted. Select such grass crops as cereal grain, corn, and pasture grasses in which broadleaf weeds are completely controlled.

Chlorpropham can be applied in safflower. After sugarbeets are well established, they too can be treated with chlorpropham. Apply the herbicide before dodder attaches to the crop—timing is important. One application of chlorpropham at 4 to 6 lb/A should control dodder in safflower or sugarbeets for about 1 month.

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The user is cautioned to read and follow all directions and precautions given on the label of the pesticide formulation being used.

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